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Toward a theory for low-frequency spin dynamics in plane copper oxide superconductors: Crossover from localized spins to weak coupling charge carriers with doping

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Abstract

We explore for all wavevectors through the Brillouin zone the dynamic spin susceptibility χtotal + , -(ω, q) that takes into account the interplay of localized and itinerant charge carriers. The imaginary part, Imχtotal + , -(ω, q), has peaks at the antiferromagnetic wavevector Q = (π, π) and a diffusive-like, extremely narrow and sharp peak (symmetric ring of maxima |q| = q0) at very small wavevectors with the nuclear magnetic/quadrupole resonance frequency ω and the superexchange coupling constant J. We demonstrate the capability of Imχtotal + , -(ω, q) for plane copper 63(1/T1) and oxygen 17(1/T1) nuclear spin-lattice relaxation rate calculations from carrier free right up to optimally doped La2 - xSrxCuO4 and obtain the basic features of temperature and doping behavior for 63(1/T 1) in agreement with experimental observations. © 2010 IOP Publishing Ltd.

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